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Chen Northern, Inc.

FINAL

WORK PLAN

HUGHESVILLE MINING DISTRICT
GALENA CREEK DRAINAGE BASIN
REMOVAL SITE INVESTIGATION
PRELIMINARY ASSESSMENT

HUTCHINSON COUNTY, MONTANA

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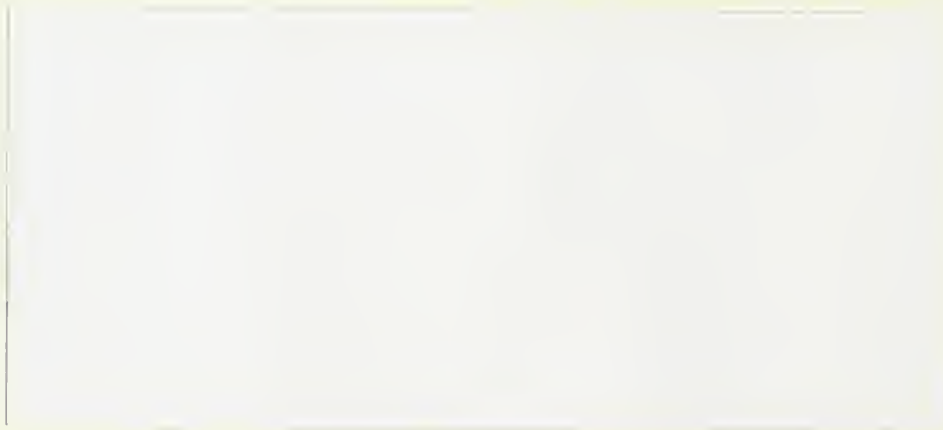
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JUDITH BASIN COUNTY, MONTANA



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GALENA CREEK DRAINAGE BASIN
REMOVAL SITE INVESTIGATION
PRELIMINARY ASSESSMENT**

JUDITH BASIN COUNTY, MONTANA

Prepared for:

Montana Department of State Lands
Abandoned Mines Reclamation Bureau
Helena, Montana

Prepared by:

Chen-Northern, Inc.
Helena, Montana

November, 1990

Copy No. 4/ of 7

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1.0 INTRODUCTION

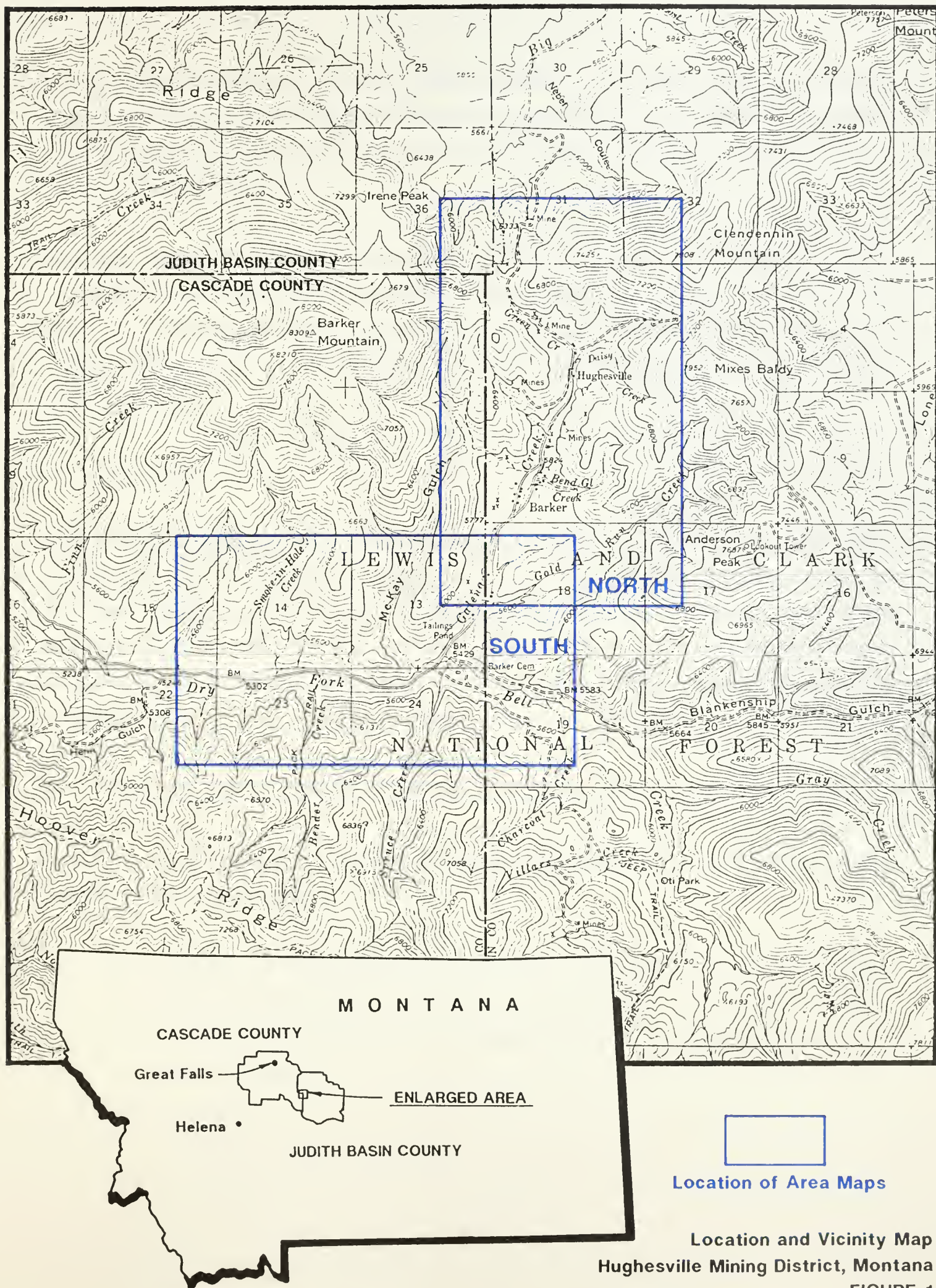
This work plan was developed to guide efforts to complete a preliminary assessment within and adjacent to the Hughesville Mining District of north-central Montana (Figure 1). Historic mining and milling activities in the area have adversely affected the quality of Galena Creek, the main drainage associated with the site. The primary environmental problems associated with the Galena Creek drainage include degraded surface water quality and increased sedimentation in the area's streams. Other environmental problems may include contaminated groundwater and soil.

The Montana Department of State Lands (MDSL) Abandoned Mine Reclamation Bureau (AMRB) has elected to initiate studies in the Hughesville Mining District to determine means whereby environmental problems and potential human health concerns can be minimized or eliminated. The first step in this process is completion of a preliminary assessment.

This preliminary assessment will be completed at the Hughesville Mining District as a precursor to initiating more specific site investigations and evaluations of various removal alternatives. This phase of the investigation is necessary because the area impacted by contamination at the site is relatively large and because there are multiple sources of contamination present in the area.

It is the intent of the AMRB to complete investigations in the Galena Creek drainage in accordance with the requirements of the National Contingency Plan (NCP), Subpart E, §300.410. Through this process, a removal site evaluation consisting of a removal preliminary assessment and removal site inspection is completed. This preliminary assessment work plan has been prepared to guide study efforts toward completion of a removal site evaluation. It is the intention of the AMRB to complete an engineering evaluation/cost analysis (EE/CA) or its equivalent following completion of this preliminary assessment and any subsequent detailed site investigations.

Following completion of the EE/CAs for the various site(s) within the study area, removal actions will be initiated. It is anticipated that the majority of the sites within the Hughesville



Mining District will follow a non-time critical schedule. It is expected that any removal actions undertaken in the Hughesville Mining District will be consistent with the final remedy selected for the site and will meet any ARARs identified for the site to the maximum extent practicable.

This work plan will guide study efforts for the preliminary assessment. Other companion documents were developed in support of the work plan for this project. These include a field sampling plan, a quality assurance project plan, a community relations plan, and a health and safety plan. All of these documents will collectively be used to achieve project objectives.

1.1 PURPOSE

The purpose of this preliminary assessment is to collate and collect site physiographic, demographic, and environmental data to provide a basis from which subsequent studies at the site can proceed. The site investigatory process to be followed during these studies is consistent with that described in the National Contingency Plan (NCP) (Federal Register, March 8, 1990). It is anticipated that more detailed investigations will be completed during subsequent phases of this project on certain portions of the site .

1.2 OBJECTIVES OF THE PRELIMINARY ASSESSMENT

Objectives of the preliminary assessment to be conducted in the Hughesville Mining District include the following:

- ◆ Collect and collate baseline information to efficiently plan and conduct more comprehensive site investigations and evaluations of removal alternatives which fully addresses the requirements of the NCP and EPA's guidance for these activities.

- ◆ Provide preliminary identification of operable units within the study area. An operable unit is defined as a discrete action that comprises an incremental step toward comprehensively addressing site problems. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.
- ◆ Provide a rational basis to prioritize subsequent removal activities within the study area.

1.3 REGULATORY BACKGROUND

The MDSL receives appropriations from the Federal Office of Surface Mining (OSM) to perform reclamation activities throughout the state. OSM receives its funding for abandoned mine reclamation projects through a tax levied on the nation's coal producers. The initial focus of the program was on reclamation of coal mine sites. Montana has recently certified that coal mine reclamation activities in the state are complete and is now directing its efforts toward reclaiming abandoned hard rock mine sites. The Hughesville Mining District was selected by the AMRB as a high priority site for reclamation activity.

The primary contaminant sources in the Hughesville Mining District and Galena Creek drainage are associated with abandoned mine and mill wastes. It is the AMRB's understanding that such materials are not classified as a RCRA hazardous waste. Because of this, studies in the Hughesville Mining District will not be specifically directed toward waste classification determination.

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) generally authorizes the EPA to respond to the release or threat of a release of a hazardous substance. Problem sites which fall under the responsibility of CERCLA are

first evaluated for ranking on the National Priority List (NPL). The ranking of specific sites on the NPL establishes the funding priorities for EPA. Sites which are listed on the NPL are under the direct involvement of the EPA or are being directed by individual state agencies with EPA oversight. The Montana Department of Health and Environmental Sciences (MDHES) Solid and Hazardous Waste Bureau, is the designated agency which administers CERCLA in Montana.

The Hughesville Mining District is currently on the Federal docket for NPL consideration. It is doubtful that the site will score high enough to qualify for the NPL. The Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) closely parallels CERCLA. The CECRA program is primarily focussing attention on sites which were listed by the EPA but did not score high enough to rank on the NPL.

Since the Hughesville Mining District does not directly or indirectly affect a large populated area, it is doubtful that the EPA or the MDHES will be the lead agency mitigating environmental problems associated with the district. Therefore, the AMRB by following the NCP process, can proceed with a removal action at the site and limit future liabilities to the state under CERCLA and CECRA.

1.4 WORK PLAN ORGANIZATION

The format and content of this work plan were based on that contained in "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988). Certain components of that format have been omitted because this study is being completed under the auspices of a removal action. This work plan includes the following elements:

- ♦ Introduction: Presents a general explanation of the purpose and objectives of completing this preliminary assessment and provides a description of the regulatory background associated with the site.

- ◆ Site Background and Physical Setting: Describes the current understanding of the physical setting of the site, the site history, and the existing information on the condition of the site.
- ◆ Conceptual Site Model, Identification of Data Gaps, and Preliminary Identification of ARARs: Presents a preliminary model of contaminant sources and pathways of contaminant movement in the Hughesville Mining District. Also identifies gaps in the data which must be filled to complete a preliminary assessment and potential ARARs for the site.
- ◆ Work Plan Rationale: Presents an approach to demonstrate how data collection activities will satisfy the data needs identified for the Hughesville site.
- ◆ Preliminary Assessment Work Tasks: Presents the tasks to be performed during the preliminary assessment. Specific descriptions of field work tasks are presented in the project sampling and analysis plan.

Specific details regarding the preliminary assessment work tasks are contained in the project sampling and analysis plan and quality assurance project plan.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

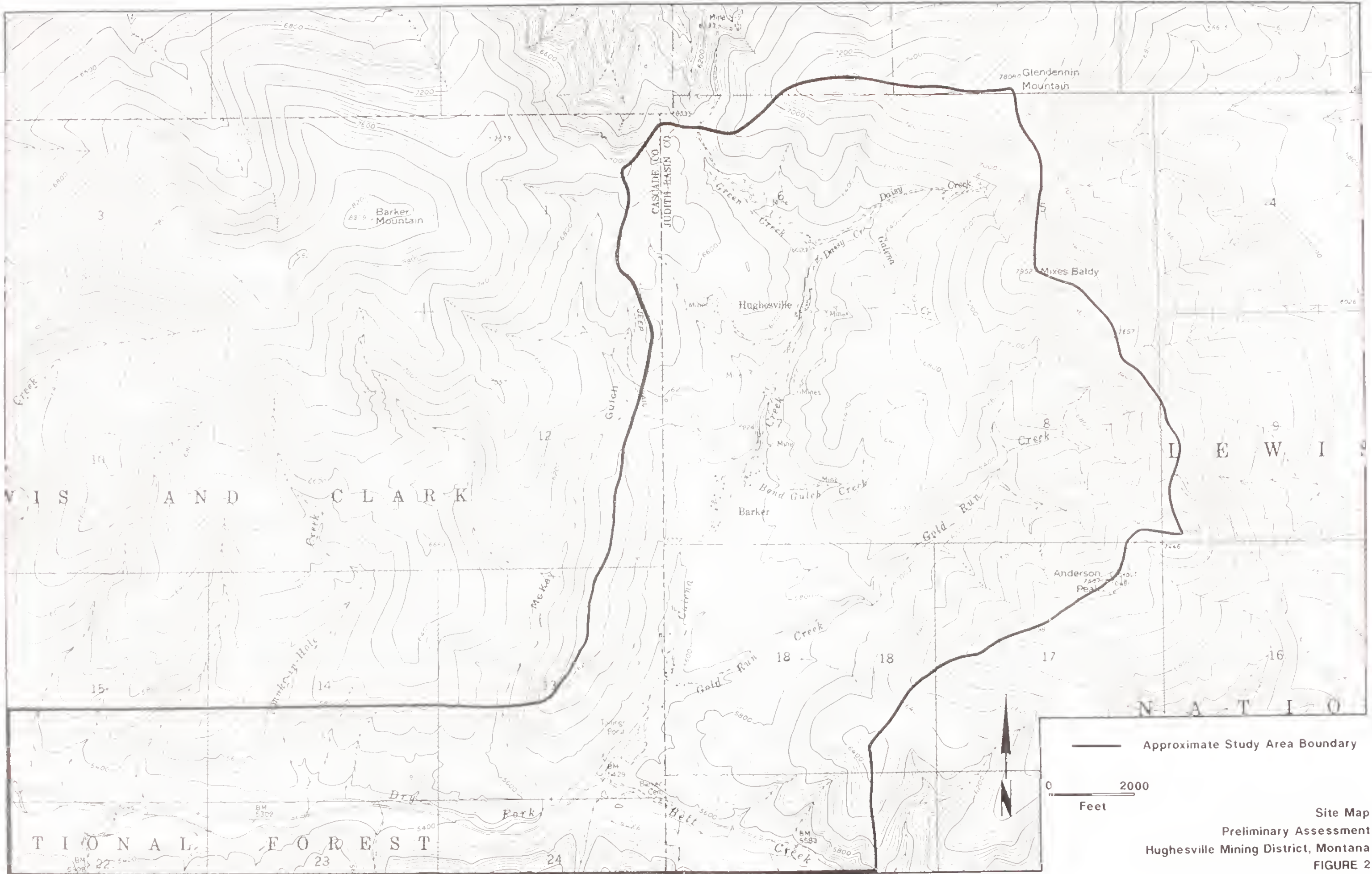
The Hughesville Mining District has historically been a major producer of silver, lead, and zinc. Historic mining and milling activity in the district has resulted in the presence of numerous mine waste dumps and tailing impoundments and the production of acid mine discharge from adits and shafts associated with the underground mines. This section of the work plan identifies the preliminary boundaries of the site and summarizes the history of mining and milling activity within the study boundary. In addition, the physical characteristics of the site are described and results of previous environmental investigations are summarized.

2.1 STUDY AREA BOUNDARIES

Our initial analyses of available environmental data for the Hughesville Mining District indicate that insufficient information is available to accurately delineate the study area boundaries for this site. For this reason, the study area to be used for this preliminary assessment will be the surface water drainage basin divide for Galena Creek and a portion of the Dry Fork Belt Creek watershed below its confluence with Galena Creek. This boundary is illustrated on Figure 2.

Use of the drainage basin divide for the study area boundary during this portion of the investigatory process is logical for the Hughesville Mining District for several reasons:

- ♦ Multiple sources of potential contamination are present within the basin. These include mine waste dumps, mill tailings, impounded tailings, streamside tailings, and acid mine drainage. There is also the possibility that other unidentified sources of contamination are present within the basin.
- ♦ The primary recipient of metals contaminants is Galena Creek and the Dry Fork of Belt Creek. A preliminary assessment focused on the surface water resources in the basin will provide data to meet project objectives. Because



— Approximate Study Area Boundary

0 2000
Feet

Site Map
Preliminary Assessment
Hughesville Mining District, Montana
FIGURE 2

the relative magnitude of environmental impacts on Galena Creek associated with the various contaminant sources within the drainage basin is unknown, it is logical to perform a preliminary assessment within an area large enough to characterize the relative significance of all potential contaminant sources. This will also provide a basis from which the various operable units can be prioritized for subsequent site-specific studies and removal alternative evaluations.

- ◆ It is presumed that a primary objective of the project is to improve environmental conditions in the area through removal actions which are designed to be consistent with the final remedy selected for the study area. It is therefore prudent to evaluate the entire Galena Creek drainage to determine the range and degree of environmental problems within the basin. This study approach will provide information to evaluate the relative improvement in water quality in response to implementation of a given removal activity.

It is probable that study area boundaries will be better defined following completion of this preliminary assessment. These may include boundaries for individual operable units. Such boundaries will be used as a basis for planning future investigative and engineering activities at the site.

2.2 OWNERSHIP

Land ownership in the Galena Creek drainage consists of patented mining claims whose surface and mineral rights are privately owned and public land administered by the Lewis & Clark National Forest. Much of the public land of economic interest has been staked by unpatented claimants who perform annual assessment work to maintain their lease on the mineral rights. Ownership of patented and unpatented mining claims in the Hughesville Mining District are grouped as follows:

♦	BLOCK P MINE	Harry J. Anderson Emerald Resources
♦	GREEN CREEK	William & Franklin Davis Pava Borgan
♦	DAISY CREEK	George A. Croff
♦	BLOCK P MILL SITE	Harry J. Anderson Emerald Resources Gwen Vaughn-Rhys McBride
♦	LIBERTY MINE	Gwen Vaughn-Rhys McBride
♦	GALENA CREEK	Harry Anderson Emerald Resources Gwen Vaughn-Rhys McBride Tobin Estate

General locations of these areas are shown on Figure 2. More precise definition of property boundaries within the study area will be completed in conjunction with this preliminary assessment.

2.3 SITE PHYSICAL CHARACTERISTICS

2.3.1 Physiography/Climatology

The Hughesville Mining District is located in Cascade and Judith Basin Counties, Montana, approximately 40 miles southeast of Great Falls (Figure 1). The district lies in the northeast portion of the Lewis and Clark National Forest, which encompasses most of the Little Belt Mountains. The Little Belt Mountains exhibit broad, elevated, plateau-like areas that generally trend southeasterly.

The district is characterized by rugged mountains which rise steeply on both sides of Galena Creek. Elevations in the area range from 5,420 feet at the mouth of Galena Creek to 7,952 feet at Mixes Baldy Mountain. Most of the watershed is forested with the exception of the lower area near the confluence of Galena and Dry Fork Belt Creek.

Most of the mines and prospects in the area are in the vicinity of the historic towns of Barker and Hughesville. These old mining camps are located in the narrow Galena Creek valley which flows southward into the Dry Fork of Belt Creek about 13 miles east from Monarch. The Galena Creek drainage contains several mine tailings dumps and an abandoned mill site with two large tailings ponds.

The climate of the Hughesville Mining District has many features associated with the "continental" type. The majority of the area's 30 inches of annual precipitation occurs during the spring. Daytime temperatures in the summer are usually hot, but not humid, and average about 75° F. Summer thunderstorms occasionally produce high winds and hail. Arctic air masses typically invade the area each winter bringing snow and blizzards. Minimum temperatures generally range from -40 to 7° F.

2.3.2 Geology

The geology of the Little Belt Mountains was studied and mapped before 1900 by Walter Weed of the U.S. Geological Survey (Weed, 1900). Weed's reports describe the general structure of the Little Belt Mountain Range as a broad, dome-shaped uplift. Sedimentary rocks near the summit of the dome are nearly horizontal; those on the northern and eastern flanks dip steeply toward the plains. Numerous laccolithic intrusions have obscured the simple folds of the uplift by further deforming the sedimentary beds, particularly about the margin of the range and immediately beyond it (Weed, 1900).

Laccolithic domes form the most prominent structural features of the mountains at Hughesville. Both Barker Mountain on the west and Mixes Baldy on the east are of laccolithic origin with cores composed of granite porphyry (Weed, 1900). Between these mountains and around their edges are the uplifted remnants of older sedimentary rocks

(ranging in age from Cambrian to Cretaceous) which dip away in all directions from the intrusive masses. Near the upper end of Galena Creek, a stock of syenite intruded igneous and sedimentary rocks. The degree of metamorphism of sedimentary rocks near the igneous intrusions is moderate; the zone of altered rocks rarely extends more than a few yards from the contact (Robertson, 1951).

The more important ore bodies of the district occur in fissure veins either in syenite or along its contact with the surrounding rocks. Other ore deposits occur as irregular replacement deposits at or near the contact of granite porphyry with Carboniferous, Devonian, or Cambrian sedimentary formations (Robertson, 1951).

2.3.3 Hydrology

Galena Creek flows for approximately three miles from its headwaters at the confluence of Daisy Creek and Green Gulch to its mouth at the Dry Fork of Belt Creek. The Galena Creek watershed is rugged and mostly forested except for a small alluvial flat near the mouth of Galena Creek. The drainage area of Galena Creek near its mouth is approximately six square miles. Galena Creek is generally perennial and flows on a narrow but relatively persistent floodplain.

Average flow in Galena Creek as measured by DNRC (1977) were about 2 cubic feet per second (cfs). Measured flows ranged from 0.5 cfs to 13 cfs. Local landowners have reported that several large flood events have occurred in the Galena Creek drainage over the past 20 years. These phenomena are evident in the cobble-sized material which blanket portions of the active floodplain.

The Dry Fork Belt Creek empties into Belt Creek at the town of Monarch. Acidic waters of the Dry Fork are diluted by the waters of Belt Creek to such an extent that a fishery is reportedly present in Belt Creek below the Dry Fork. Belt Creek flows into the Missouri River approximately 10 miles northeast of Great Falls.

Water quality in the Galena Creek drainage is significantly degraded by discharge from abandoned mine shafts and adits, leachate from mine/mill waste and tailings dumps, and erosion of mine waste and disturbed areas. DNRC (1977) water quality data indicate Galena Creek near its mouth is very poor and exceeds several primary and secondary drinking water standards and Gold Book criteria including pH, iron, cadmium, copper, manganese, and zinc. Galena Creek and a portion of the Dry Fork Belt Creek below Galena Creek do not support aquatic life. Acid mine drainage entering Galena Creek from multiple sources is the probable cause of the lack of an aquatic community in the streams.

Water in Dry Fork Belt Creek above its confluence with Galena Creek is of good quality. No exceedances of either drinking water standards or aquatic criteria have been measured in this reach of the stream. The quality of water in the Dry Fork Belt Creek degrades measurably below the confluence with Galena Creek. DNRC (1977) data indicate zinc concentrations exceed both chronic and acute water quality criteria during runoff events. Suspended solids contained in runoff water are likely derived from areas disturbed by mining in the Galena Creek drainage and the tailings ponds at the mill site near the mouth of Galena Creek.

The Dry Fork Belt Creek below Galena Creek contains numerous deposits of tailings material along its banks which have been transported and deposited during high runoff events. The impact of these deposits on the quality of water in Dry Fork Belt Creek is unknown.

2.3.4 Hydrogeology

Minimal information is available regarding the groundwater resources of the Hughesville Mining District. A well and spring inventory has not been completed. The district hosts several discharging adits which provide some indication of the groundwater system in the area. It is expected that the hydraulics and quality of groundwater in the area's bedrock system is controlled by the presence or absence of fractures and by the extensive network of mine tunnels associated with the district.

Galena Creek flows on a narrow floodplain which likely hosts a relatively small alluvial groundwater system. The interrelationships between Galena Creek and the alluvial groundwater system have not been documented.

A landowner near the town of Barker reportedly does not consume water obtained from her domestic well because of visible iron discoloration (Gwen McBride, personal communication, September, 1990). This well is reportedly completed in fractured bedrock near an altered stratigraphic zone. Such information may suggest that naturally contaminated groundwater may be present in the study area. Additional groundwater information will be obtained during this preliminary assessment to provide a better basis with which the hydrogeological environment of the area can be evaluated.

2.3.5 Soils

Detailed soil information for the Galena Creek drainage is not available. The only available regional soils information is contained in a Soil Conservation District (SCS) soil survey (SCS, 1967). This survey was completed for the Judith Basin area of Montana. This soil survey was extended south to the national forest boundary as far as the drainage divide between Green Creek and Big Otter Creek.

Soils mapped along the edge of the SCS Judith Basin area near the Galena Creek drainage were identified as belonging to the Hughesville-Duncom Complex. These soils are moderately deep to shallow, loam to clay loam soils over limestone bedrock. Vegetation associated with these soils consists of grass and forest cover.

Soils in the Hughesville Mining District would probably not be classified as Hughesville-Duncom Complex soils because of a difference in bedrock parent materials. Underlying bedrock in the Hughesville District is primarily composed of granite porphyry and syenite. Soils on granitic bedrock are characteristically shallow on steep slopes such as those present in the Hughesville District. It is probable that soils in the study area are moderately developed, have a thin organic horizon, a four to six-inch thick A Horizon, and exhibit pH's ranging from 4.5 to 6.5 standard units. Additional soil information will be collected during this preliminary assessment as needed.

2.4 MINING/MILLING HISTORY

The silver-lead deposits near Barker, Montana (first known as Clendennin), were discovered on October 23, 1879, by Buck Barker and Pat Hughes (Robertson, 1951). Other discoveries were soon made which resulted in a rush to the new camp. Hundreds of claims were located and feverish mining activity resulted. Several of the mines soon became important producers.

Large quantities of high-grade ore were mined and hauled to Fort Benton by pack train or horse/oxen-drawn wagons where it was shipped by river steamers to Kansas City, St. Louis, and elsewhere for ocean shipment to Swansea, Wales, for smelting (Robertson, 1951). To avoid excessive transportation costs, smelters were constructed at Clendennin and at Hughesville, but much of the high-grade ore and bullion produced during 1883 and 1884 was shipped by river to Omaha. The smelter at Hughesville was operated only a short time because the furnace did not have a suitable refractory lining. The 40-ton smelter at Clendennin was equipped with a water jacketed furnace. This smelter was operated about 18 months by Col. George Clendennin and produced \$375,000 worth of bullion (Robertson, 1951).

Mining operations in the Barker district waned during the late 1800's with the depletion of the rich, near-surface, argentiferous, lead-carbonate ore bodies. Deeper exploration in most of the mines developed lower-grade base ore that could not be mined and shipped at a profit.

A railroad was constructed from Monarch to Barker in 1891. Several of the larger mines then resumed operations. The demonetization of silver in 1892, however, forced most of them to close. The spur line from Monarch to Barker was removed in 1902.

After some years of inactivity, the Block P mine was leased to the United Smelting and Refining Company in 1898 (Robertson, 1951). The company operated the mines until about 1902, shipping the ore to its smelter at Great Falls. Ownership of most of the claims by that time had been acquired by T.C. Power, who then organized the Block P

Mining Company. The company was named after the flag design of Power's Missouri River steamboats. This company and lessees then operated the mine intermittently on a small scale.

A 75-ton gravity mill was built during 1910 and 1911. Mill capacity was increased to 100 tons in 1920. Operations continued more or less steadily until 1927 when the Block P Mining Company holdings were purchased by the St. Joseph Lead Company. The company constructed a modern, 400-ton, selective flotation plant at a site just south of Barker (Robertson, 1951). The railroad spur from Monarch to Barker was also rebuilt. The mine was equipped with a new steel headframe and ore bins and extensive development was done. A 10,250 foot aerial tramway was constructed between the mine headframe and the new flotation plant. Mining and milling continued steadily until September 30, 1930, when all operations were suspended because of unfavorable market conditions (Robertson, 1951).

Operations resumed in 1941 and continued until October, 1943, when all company operations ceased. The mine and most of its equipment were sold to Thorson Brothers and Brazee. The mill was dismantled, the railroad tracks were removed, and the railroad right-of-way was abandoned.

Thorson Brothers and Brazee sold their holdings about a year later to the American Smelting and Refining Company but reserved the right to mine ore from the adits above the collar of the shaft which they did for some years thereafter. The Block P property was sold to its present owners, Harry J. Anderson and Peter Antonioli (Emerald Resources) in 1973.

The Block P properties were leased to Amax Exploration, Inc. in 1981. Amax was issued a permit by the Montana Department of State Lands to re-establish mining operations in a portion of the district. Their mining plans called for reprocessing of the mine dumps and old tailings pond for residual ore. To date, none of the tailings material from the mine

dumps or mill tailings ponds have been reprocessed. Recent exploration activities have added mine waste to the Block P mine dump and have increased the extent of disturbed areas at several mine sites.

2.5 PREVIOUS SITE INVESTIGATIONS

Previous environmental investigations in the Hughesville Mining District include two studies completed by the Montana Department of Natural Resources and Conservation (DNRC) and a preliminary site investigation conducted by the Montana Department of State Lands Abandoned Mine Reclamation Bureau.

The purpose of these three investigations was to evaluate water quality degradation in the Galena Creek drainage and to develop potential remediations for identified water quality problems. In addition to these studies, the AMRB also completed an inventory of all mining related disturbances in the Hughesville District in 1989. This section summarizes data resulting from these studies.

2.5.1 Data Summary

The DNRC studies were conducted between 1973 and 1978. During that period, both a Feasibility Study (DNRC, 1977) and Demonstration Project (DNRC, no date) were completed to investigate silver-lead mine waste manipulation for acid mine drainage control. The feasibility study and demonstration project attempted to: identify acid mine drainage problems in Galena Creek and the Dry Fork of Belt Creek; document water quality conditions at that time; recommend abatement methods; and, demonstrate mitigation measures at the Block P Mine dump.

The DSL study (DSL, 1988) was initiated to facilitate an application for a Reclamation and Development Grant from the DNRC. This grant application was submitted to the DNRC by the AMRB in May, 1988. The purpose of the proposed reclamation project was to remediate off-site impacts emanating from the mill tailings pond near the mouth of Galena Creek.

Data collected during the DNRC feasibility study included streamflow measurements and water quality data in Galena Creek and the Dry Fork of Belt Creek. Climatological data were also collected from a weather station installed in Barker, Montana, midway up Galena Creek.

Streamflow measurements were gathered from five stream gaging stations located on Galena Creek both upstream and downstream of the Block P Mine dump. The stream gaging stations were located on both the main stream channel and at certain adit and spring discharges. Daily streamflow data were collected from the five stream gaging stations from September, 1973 to November, 1974 and between April and October of 1976. Streamflow data were also gathered from as many as 26 other water quality sampling stations between May, 1973 and October 1977. Streamflows were measured monthly at seven of these sampling stations during that period and infrequently at the balance of the sampling stations.

Water quality data were collected monthly from seven water quality sampling stations between May, 1973 and October, 1977. An additional 24 sampling stations were sampled at least once during that period with a few stations sampled several times. Water quality analyses were performed by the Montana State Water Quality Bureau laboratory in Helena. An initial round of water quality samples were analyzed for a complete suite of parameters which included the following:

Calcium	Magnesium	Sodium
Potassium	Iron	Manganese
Aluminum	Chloride	Sulfate
pH	Temperature	EC
Hardness	Turbidity	SAR
Cadmium (dissolved)	Zinc (dissolved)	Iron (TR)
Copper (TR)	Cadmium (TR)	Silver (TR)
Lithium (TR)	Mercury (dissolved)	Copper(diss)
Acidity (as CaCO ₃)	Zinc (TR)	Mn (TR)
Silver (dissolved)	Lithium (dissolved)	Aluminum(TR)

This initial list of parameters was abbreviated for most of the remainder of the study. Parameters of greatest interest were chosen based on abundance and persistence and included the following:

Temperature	EC	pH
Acidity	Iron (total)	Mn (total)
Sulfate	Cadmium (dissolved)	Cadmium (TR)
Copper (dissolved)	Copper (TR)	Zinc (TR)
Zinc (dissolved)	Iron (TR)	

Water quality data was graphed to illustrate trends and correlations between parameters. Graphical data included the following:

Mn, Fe, Zn	Percent of total load at lower weir versus time between July, 1973 and September, 1974;
Fe, Zn, Mn, Cu	Concentration versus flow at stations DF1, DF2, DF4, DF5, and DF7;
Zn, Mn, Fe	Concentration versus time and load versus time at stations DF1, DF2, DF3, DF5, DF6, and DF7.

Data analyzed for the DSL Reclamation and Development Grant were limited to water quality samples gathered from three stations located below the Block P Mill Tailings pond. Samples were collected on May 31, 1979 and October 22, 1979 at the mouth of Galena Creek and on Dry Fork of Belt Creek above and below the mouth of Galena Creek. Parameters included pH, EC, sulfate, and four metals.

In addition to the data summarized above, AMAX Exploration, Inc. drilled and installed several monitoring wells in the vicinity of the Block P tailings pond. AMAX has been contacted and has agreed to release their data to the DSL. To date, this information has not yet been received.

2.5.2 Data Quality

The quality of the data gathered during previous site investigations could not be quantified because of a lack of project background documentation discussing sampling and analysis procedures. In addition, these data were collected during a seven year period over ten years hence and may not be strictly comparable or representative of current conditions. However, because all surface water data collected during the Feasibility Study and Demonstration Project were completed under the authority of a U.S. Environmental Protection Agency grant, adequate quality control procedures were probably implemented during the project.

It is our opinion that these data can be used to identify trends in water quality and potential sources of environmental degradation. These data should be augmented with a minimum amount of surface water data to confirm current water quality conditions in the area and to provide a basis for evaluating previous data.

2.5.3 Results and Conclusions

The following conclusions and recommendations were reached as a result of previous water quality investigations.

- ◆ Water quality in Galena Creek and the Dry Fork Belt Creek is substantially influenced by acid mine drainage (AMD) from old lead and silver mines. Water quality in this drainage area is extremely poor at the Liberty Mine seep, a spring at the Block P Mine, and a spring in Galena Creek near some abandoned mine cars. The quality is better in the Dry Fork Belt Creek below Galena Creek and in Galena Creek above the mining area, but the water is still toxic to most aquatic life. Concentration of metals in the streams is not significantly diluted by rainfall or melting snow.
- ◆ During spring-time conditions, the spring at the Block P Mine contributes from 20 to over 80 percent of the total metal load in Galena Creek leaving

the project area. The spring at the abandoned mine cars in Galena Creek also contributes from 20 to over 60 percent of the total metal load leaving the project area. The total load in Galena Creek immediately below the Block P Mine dump varies from less than 40 to over 100 percent of the total load leaving the project area, which indicates that the Block P Mine dump is a major source of pollutants.

- ◆ Silver Creek normally contributes a small portion of the total metal load leaving the project area, but at times it contributes in excess of 10 percent of the load. The Liberty Mine seep exhibits poor quality water. Its flow is intermittent and thus it contributes only a small percentage of the total waste load entering Galena Creek.
- ◆ Several methods were considered for treatment and abatement of the area's AMD problem. Surface manipulation of mine waste dumps and streams in the area, one of the investigated methods, appeared feasible from the points of view of cost, effectiveness, and adaptability to the hostile climate. The DNRC project eventually implemented this surface manipulation concept at the Block P Mine by sloping/shaping the top of the Block P Mine dump, topsoiling and revegetation, and installation of a diversion pipeline. The results of the project did not show a marked improvement in water quality in the drainage.
- ◆ Based on pilot tests, limestone neutralization reduced concentrations of iron and copper, raised pH, but did not significantly reduce loads of zinc, manganese, or cadmium in Galena Creek. Cottrell dust (a lime waste from cement plants) was tested for neutralization ability and significantly reduced loads of all metals investigated. A combination of limestone treatment and reaction with Cottrell dust appears to be the most economical alternative for neutralization. Neutralization was not recommended because of the high cost of annual maintenance and poor accessibility to the site in winter months.

- ◆ Other methods of abatement investigated but not recommended because of high costs were removal of mine tailings piles, ponding and aeration, evaporation, reverse osmosis, electrodialysis, ion exchange, and freezing.

Water quality in Galena Creek has been significantly influenced by AMD from old metal mines. The mechanism for producing acid involves interaction of pyritic minerals, oxygen and water. The acidic water condition produced from the reaction causes other metals to become soluble and enter the aquatic system. Toxic metals entering the Galena Creek system in this way include cadmium, zinc, iron, manganese, lead, copper, arsenic, and aluminum.

3.0 CONCEPTUAL SITE MODEL AND DATA GAPS

This section of the work plan described the types and volumes of wastes presently identified within the study area. A conceptual model of contaminant migration pathways is also discussed. Finally, gaps in the existing data for the project site are described relative to meeting project objectives.

3.1 TYPES AND VOLUMES OF WASTES PRESENTLY IDENTIFIED

The primary wastes present within the study area are mine and mill wastes associated with several historic underground mines. These wastes include both waste rock and tailings material. The difference between the material types is not easily identifiable. The waste rock is generally relatively coarse material and is located in dumps below mine openings. Mine and mill tailings is typically sand-sized and is visible as an orange-brown material which is usually devoid of vegetation. Tailings material is intermixed with mine waste rock and is located on the floodplain of both Galena Creek and the Dry Fork Belt Creek.

Two relatively large impoundments are located near the mouth of Galena Creek. These features were used to impound tailings materials from the Block P mill site located at the northern end of the structures. These features represent the only attempt to control releases from historic mining and milling facilities which occurred in the area.

Estimated volumes of waste rock and tailings material for the various known mine and mill sites are summarized in Table 1. Volume estimates contained in Table 1 were recorded during the AMRB's inventory of the Hughesville Mining District and were derived through a gross measure. No estimates of the volume of streamside tailings in the study area have been made. Likewise, estimates of waste material associated with smaller mine sites in the area have not been made.

No information is currently available to characterize the chemistry of any of the waste material within the drainage basin. Several samples of waste rock and tailings material

TABLE 1
ESTIMATED VOLUMES OF WASTE ROCK AND TAILINGS MATERIAL
Preliminary Assessment
Hughesville Mining District, Montana

Name	Type Material	Estimated Volume ⁽¹⁾ (cubic yards)
Block P Dump	Waste Rock	250,000
Block P Tailings	Mill Tailings	500,000
Mck	Waste Rock	320
SWNE Sec. 1	Waste Rock	50
MTA	Waste Rock	700
May Patent	Waste Rock	60
NESE Sec. 31	Waste Rock	170
NESW Sec. 22	Waste Rock	100
NWNE Sec. 31	Waste Rock	380
NWSW Sec. 22	Waste Rock	20
SWSE Sec. 30	Waste Rock	450
Wright/Edwards	Waste Rock	100,000
Liberty	Waste Rock	10,000
Danny "T"	Waste Rock	5,000
Marcelline	Waste Rock	1,000

(1) Volume estimates obtained from various sources including the 1989 AMRB inventory notes DNRC publications, and other field estimates.

were collected by the AMRB in conjunction with their recently completed environmental assessment of the area. These data will be evaluated during performance of this preliminary assessment. It is probable, however, that the primary contaminants of concern associated with the wastes are metals.

3.2 POTENTIAL PATHWAYS OF CONTAMINANT MIGRATION

Contaminants associated with mine wastes in the Galena Creek drainage migrate by several pathways to environmental receptors and, potentially, to human receptors. This section presents a preliminary evaluation of the potential migration and exposure pathways from which a conceptual model for assessment of site impacts can be made. The evaluation is based on currently available surface water analytical data, physical site information, and our experience with evaluating contaminant migration characteristics in similar environments.

3.2.1 Air Pathway

The atmospheric transport of site contaminants may be an exposure pathway of concern in the Galena Creek drainage. Multiple mine waste dumps, streamside tailings, and impounded tailings all represent potential sources for airborne transport of metals. Few year-round residents are present in the area; most persons who own houses in the area are present on a seasonal basis. Because of this, it is unlikely that any humans are subjected to chronic exposure via this pathway. The impact on the environment from contaminants transported via the air pathway is unknown.

Little information is available to determine the significance of mine waste material in the area as a source for airborne transport. If it is assumed that a certain fraction of the material is silt-sized and smaller, it is probable that blowing dust could occur in the area. Data to be collected during the preliminary assessment will provide cursory information on the physical and chemical characteristics of the mine waste material with which the relative significance of this pathway of contaminant movement can be evaluated.

Estimates of the number of full time and seasonal residents along with the location of their residences relative to the tailings deposits will be made to further evaluate the significance of the air pathway.

3.2.2 Surface Water Pathway

Surface water is the primary recipient of contaminants in the study area. Galena Creek is visibly off-colored, presumably because of iron enrichment. Exposed mine wastes in the area are situated such that erosion could occur from either snowmelt runoff or precipitation-induced runoff events. The material is ultimately transported into Galena Creek and the Dry Fork Belt Creek.

The contact time between mine waste sediments and the surface water is likely variable depending on the disposition of the material being transported. A portion of the material is probably flushed out of the surface water system and into Belt Creek. Other material is deposited during high flow events on the streambanks of both Galena Creek and Dry Fork Belt Creek. This material is then positioned for re-entrainment during subsequent high flow events. Finally, a certain portion of the sediments are contained in the active surface water courses as bedload. This material is subject to continuous leaching and associated metals liberation.

The form in which metals contaminants in the surface water system occur has not been documented. Determination of the fractionation of metals in surface water may be necessary to evaluate the bioavailability of metals. It is probable that the total versus dissolved fraction ratio in Galena Creek changes in response to flow conditions and antecedent conditions. The need to evaluate the form in which metals are transported in the area's surface water systems will be evaluated during the preliminary assessment.

3.2.3 Groundwater Pathway

Groundwater transport may be a significant pathway of contaminant migration in the Galena Creek drainage. Input of metals-laden groundwater to Galena Creek has been

documented in the vicinity of the Block P mine dump. Mine adit discharges also convey metals contaminants which probably affect the surface water resources in the area. It is probable that the most significant impact resulting from groundwater inflow to Galena Creek is realized during low flow and baseflow conditions in the stream. Consequently, an effort will be made during this preliminary assessment to evaluate groundwater and the associated environmental impacts associated with this pathway.

3.2.4 Soil Pathway

Migration of waste materials to surrounding off-site soils is probably occurring in the Galena Creek drainage to some extent owing to the position of many of the waste dumps on steep hillsides. There is also the possibility that blowing dust emanating from the waste dumps has contaminated adjacent soils. The likelihood of exposure to the general public through soil ingestion or direct skin contact is remote because the waste material is generally located on private land. The most likely direct contact exposure route would be associated with residents of the area who live near waste sources on a seasonal basis.

Certain sites (e.g. the Block P Mine) contain historical structures that lure a small number of tourists to the area. It is the intent of this preliminary assessment to gather surficial soils data to evaluate the soil pathway with respect to environmental impacts, and to a lesser extent, to human health risks. Human health risks will be evaluated by determining the location of residences in relation to waste material.

3.3 IDENTIFIED DATA GAPS

Several gaps in the existing data were identified which will need to be filled to meet project objectives. These data gaps are summarized below.

- ♦ Soils/Tailings -- No analytical or physical data are available for soils and tailings in the study area. A few samples were recently collected during AMRB's environmental assessment of the Hughesville District. These data,

when available, will be reviewed and used in completing the preliminary assessment of the site. A certain level of knowledge regarding the chemical and physical characteristics of the mine waste material at the various source areas is necessary to determine the significance of environmental impacts associated with an individual site. Further, more accurate determinations of volumes of waste material are necessary to support preliminary identification of remedial alternatives for the waste sites.

- ◆ Surface Water - An abundance of surface water data were collected by the DNRC in conjunction with their studies of the Hughesville District during the 1970s. A minimal amount of surface water quality and flow data are needed to determine if conditions at the site have changed since the DNRC study. In addition, surface water data are needed to evaluate the representativeness of the DNRC data with respect to QA/QC considerations.
- ◆ Groundwater - No groundwater data have been secured for the study area. Efforts have been made to contact AMAX Gold Exploration, Inc. regarding data on monitoring wells they installed near the tailing impoundments at the mouth of Galena Creek. These data will be used during the preliminary assessment if they become available. Cursory groundwater data are needed to determine if the area's groundwater system is impacted by waste source areas or if groundwater is impacting surface water courses. Data needs include both chemical and hydraulic information at key locations within the study area.

3.4 PRELIMINARY IDENTIFICATION OF ARARs

The NCP (Subpart E §300.415) requires removal actions, pursuant to CERCLA section 106, attain applicable or relevant and appropriate requirements (ARARs) under federal environmental or state environmental or facility siting laws to the extent practicable. These requirements must be applicable or relevant and appropriate in light of the hazardous

substances, pollutants, or contaminants present at the site and under the circumstances of the release.

In determining which requirements are relevant and appropriate, the criteria differ depending on the type of requirement under consideration (i.e. chemical-specific, location-specific, or action-specific). According to the NCP, chemical-specific ARARs are usually health or risk-based numerical values which establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. An example of a chemical-specific ARAR would be maximum contaminant levels associated with the Safe Drinking Water Act.

Location-specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Action-specific ARARs are usually technology-based or activity-based requirements or limitations on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. Removal alternatives which involve, for example, closure or discharge of dredged or fill material may be subject to ARARs under RCRA and the Clean Water Act, respectively.

A review of ARARs will be completed in conjunction with the preliminary assessment for the Galena Creek drainage. As more information is obtained about the site and as removal alternatives are considered, Federal and State requirements will be narrowed to those which are potential ARARs for each alternative. More ARARs may need to be identified during the removal design phase of the study as the specific details of the removal action are developed.

4.0 WORK PLAN RATIONALE

The objective of the work plan approach to completing this preliminary assessment is to gain a general understanding of the nature and extent of potential releases of contamination to provide a basis from which subsequent RI/FS activities can commence. In order to meet this general objective, several more specific objectives must be met. These are discussed in this section.

4.1 IDENTIFICATION OF DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during removal response activities. DQOs are determined based on the end uses of the data to be collected. According to *Data Quality Objectives for Remedial Response Activities - Development Process* (USEPA, 1987), DQOs are developed through the following three-stage process:

- ◆ Stage 1 - Identification of decision types
- ◆ Stage 2 - Identification of data uses/needs
- ◆ Stage 3 - Design of the data collection program

Stage 1 defines the types of decisions to be made regarding site remediation through identifying data users, evaluating available data, developing a conceptual model, and specifying objectives for the project. The general decision types are identified early in the scoping process to ensure that the site investigation approach will yield sufficient data to support the decisions. Stage 1 is encompassed in the development of the work plans. An evaluation of existing data collected in the Hughesville Mining District is presented in Section 2.5 of this work plan.

Stage 2 of the DQO process defines data uses and the specific data types necessary to meet the project objectives. Although general data uses are defined during Stage 1,

specific uses of the data are identified during Stage 2. Stage 1 determines if existing data are sufficient, and if the data are insufficient, the types, quality, and quantity of data which must be collected will be determined during Stage 2. Stage 2 begins after the conceptual model is developed and the overall project objectives are established. The conceptual model and the general decisions become the basis for determining data uses and needs. This stage includes development of the scope of work and incorporation of the scope of work tasks into the work plans.

Stage 3 of the DQO process includes the actual design of the detailed data collection program for the preliminary assessment. This stage includes assembly of the Preliminary Assessment Work Plan, the Sampling and Analysis Plan (SAP), and the Health and Safety Plan (HSP). These plans will be used during data collection activities to ensure that program procedures are followed and the DQOs are met.

A summary of the DQOs for the preliminary assessment data collection activities is provided in the Quality Assurance Project Plan (QAPP) which accompanies this work plan. In addition, DQOs are specified in the appended Field Sampling Plan (FSP) for each of the data collection activities associated with the site characterization.

5.0 PRELIMINARY ASSESSMENT WORK TASKS

Several work tasks will be completed to fulfill objectives identified for the project in Section 1.0. These work tasks will be completed in an iterative fashion. Collected data will be analyzed as soon as possible such that any changes in the scope of the investigation can be implemented expeditiously.

5.1 TASK 1 - PROJECT PLANNING

The purpose of the project planning (or scoping) work task is to define the appropriate type and extent of site investigation and analytical studies necessary to generally characterize the site. The main objectives of scoping are to identify the types of decisions that need to be made, to determine the types of data needed (including quantity and quality), and to design the studies necessary to collect these data. Initially, the task involves a site inspection of the study area and an analysis of existing information for the facility. This task also includes development of the Preliminary Assessment Screening Work Plan, the Sampling and Analysis Plan, the Health and Safety Plan, and the Community Relations Plan.

During scoping, a conceptual model of the site is established that considers the source of contamination, potential pathways of exposure, and potential receptors. Data gathered during the preliminary assessment will build on that model. A conceptual model of the Hughesville Mining District is described in Section 3.0.

The following is a description of the contents of each of the work plans which will be provided as part of the scoping task. All of the work plans described were written in accordance with the current NCP.

5.1.1 Preliminary Assessment Work Plan

The purpose of the Preliminary Assessment Work Plan (this document) is to present the rationale and methodology for conducting the preliminary assessment. The Preliminary

Assessment Work Plan includes the following elements:

- ◆ A description of the project along with discussions of the site background
- ◆ A conceptual model of the study area
- ◆ A history of regulatory and response actions
- ◆ A discussion of data quality and quantity objectives
- ◆ A detailed description of the work tasks to be performed
- ◆ A project schedule for each of the required activities

5.1.2 Sampling and Analysis Plan

The Sampling and Analysis Plan (SAP) contains the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). For each field activity, the FSP outlines the sampling objectives, necessary equipment, sample types, location and frequency, analyses to be performed, and a schedule of when the particular sampling will occur. The FSP includes a separate plan for the following field activities: surface water sampling and flow measurements, gaging station installation and operation, soil and mine waste sampling, monitoring well installation, groundwater sampling, and aquifer testing.

The purpose of the QAPP is to provide a detailed description of the quality assurance/quality control (QA/QC) procedures to be employed during the preliminary assessment. The objectives of the QAPP are to ensure that the preliminary assessment is based on the correct level and extent of sampling and analysis required to produce sufficient data for evaluating remedial alternatives. A second objective is to ensure the quality of the data collected during the preliminary assessment. The QAPP, which was written in accordance with the current NCP and addresses all of the field investigations conducted as a part of site characterization activities. It includes the following discussions:

- ♦ A project description
- ♦ Project organization illustrating the lines of responsibility to the personnel involved in the sampling phase of the project
- ♦ Quality assurance objectives for the data acquired, including accuracy, precision, completeness, representativeness, comparability, and intended use of the data
- ♦ Sample custody procedures
- ♦ The type and frequency of calibration procedures for field and laboratory instruments
- ♦ Analytical procedures
- ♦ Data reduction, validation, and reporting procedures
- ♦ Internal quality control procedures
- ♦ Performance and systems audits
- ♦ Preventative maintenance procedures
- ♦ Specific routine procedures used to assess data
- ♦ Corrective actions
- ♦ Quality assurance project reports

5.1.3 Health and Safety Plan

The Health and Safety Plan (HSP) developed for the preliminary assessment was based on the expected site conditions to protect personnel involved in site characterization activities. The plan addresses all applicable regulatory requirements under 29 CFR 1910.120. The HSP will provide a site background discussion and describes personnel responsibilities, protective equipment, health and safety procedures and protocols, decontamination procedures, personnel training, and medical surveillance.

5.2 TASK 2 - COMMUNITY RELATIONS

The community relations task is designed to obtain community input on the preliminary assessment. A community relations plan (CRP) was prepared for use by the MDSL, as the lead agency.

Although most of the community relations activities will be conducted by MDSL personnel, Chen-Northern will provide technical support at public meetings, as necessary.

5.3 TASK 3 - COLLATION OF EXISTING INFORMATION AND MAP ASSEMBLY

A base map of the project area will be produced on which existing data and data collected during the preliminary assessment can be plotted. Development of detailed base map is also necessary to support project planning, present information, and provide a means by which subsequent removal alternative evaluation activities can be completed.

Two types of maps will be produced during the preliminary assessment. A photo-base map at a scale of 1 inch = 1000 feet will be prepared. In addition, a 1 inch = 500 feet topographic base map will be developed of key areas within the study area. These maps will include areas with adits, shafts, and mine waste dumps and will also include the Galena Creek floodplain.

All available existing information for the project site will be collated and reviewed.

Historical water quality data will be entered into the project data base, described in the QAPP. Other types of information to be sought include:

- ♦ Demographic data
- ♦ Land use
- ♦ Land ownership
- ♦ Mine wastes
- ♦ Adit and shaft locations
- ♦ Environmental data collection sites
- ♦ Domestic well locations
- ♦ Spring locations
- ♦ Mineral Ownership

This information will be plotted on the photo-base map for the project area and summarized on tables. Mine waste mapping will include an initial delineation using aerial photographs. This map will be verified by field truthing completed under Task 4.

5.4 TASK 4 - FIELD INVESTIGATIONS

The primary objective of the site investigation is to provide additional data to evaluate the general environmental characteristics of the Hughesville Mining District. The investigation will provide additional information with which project objectives can be achieved. Table 2 summarizes field activities to be completed during this preliminary assessment.

The field investigations will be conducted under the guidance of the FSP, QAPP, and HSP work plans developed during Task 1. All of the sample locations have been identified on maps provided in the FSP. Data management and QA/QC activities will be conducted in accordance with the procedures outlined in the QAPP. On-site health and safety procedures described in the HSP will be followed.

TABLE 2
SUMMARY OF FIELD ACTIVITIES
Preliminary Assessment
Hughesville Mining District, Montana

FIELD ACTIVITY	GENERAL PURPOSE	ULTIMATE DATA USE
Surface Water Sampling	Characterize hydrology and identify contaminant source areas	Identify relative significance of various contaminant source areas Identify operable units
Monitoring Well Installation	Characterize hydrogeology	Provide baseline information Provide access for groundwater sampling
Groundwater Sampling	Characterize hydrogeology	Provide baseline information Evaluate removal alternatives
Aquifer Testing	Characterize hydrogeology	Evaluate removal alternatives
Soil/Mine Waste Sampling	Characterize magnitude of metals contamination Characterize physical properties of material	Identify and prioritize operable units Evaluate removal alternatives

5.5 TASK 5 - SAMPLE ANALYSIS AND VALIDATION

This task involves development of a data management system, including field logs, sample management and tracking procedures, and QA/QC procedures for both laboratory data and field measurements. The purpose of the data management system is to ensure that the data collected during the preliminary assessment are of adequate quality and quantity to meet the objectives of the project. The data collected will be validated at the field or laboratory QC level to determine whether it is adequate to be used as intended. A detailed description of the field and laboratory data validation procedures is provided in the QAPP.

5.6 TASK 6 - DATA EVALUATION

This task includes reduction, tabulation, and evaluation of data obtained from the site investigation that will be included in the preliminary assessment report. Results of the analyses will be summarized and tabulated in a logical manner. The data will be summarized in the preliminary assessment report such that project objectives are met.

5.7 TASK 7 - PRELIMINARY ASSESSMENT REPORT

The preliminary assessment report will document the investigations, data, interpretations, and conclusions drawn during the preliminary assessment. The report will be submitted to the AMRB for review and approval. A final preliminary assessment report will be prepared reflecting AMRB comments.

5.8 TASK 8 - MONTHLY REPORTS

Monthly reports will be prepared for submittal to the AMRB. The following items will be included in the monthly reports:

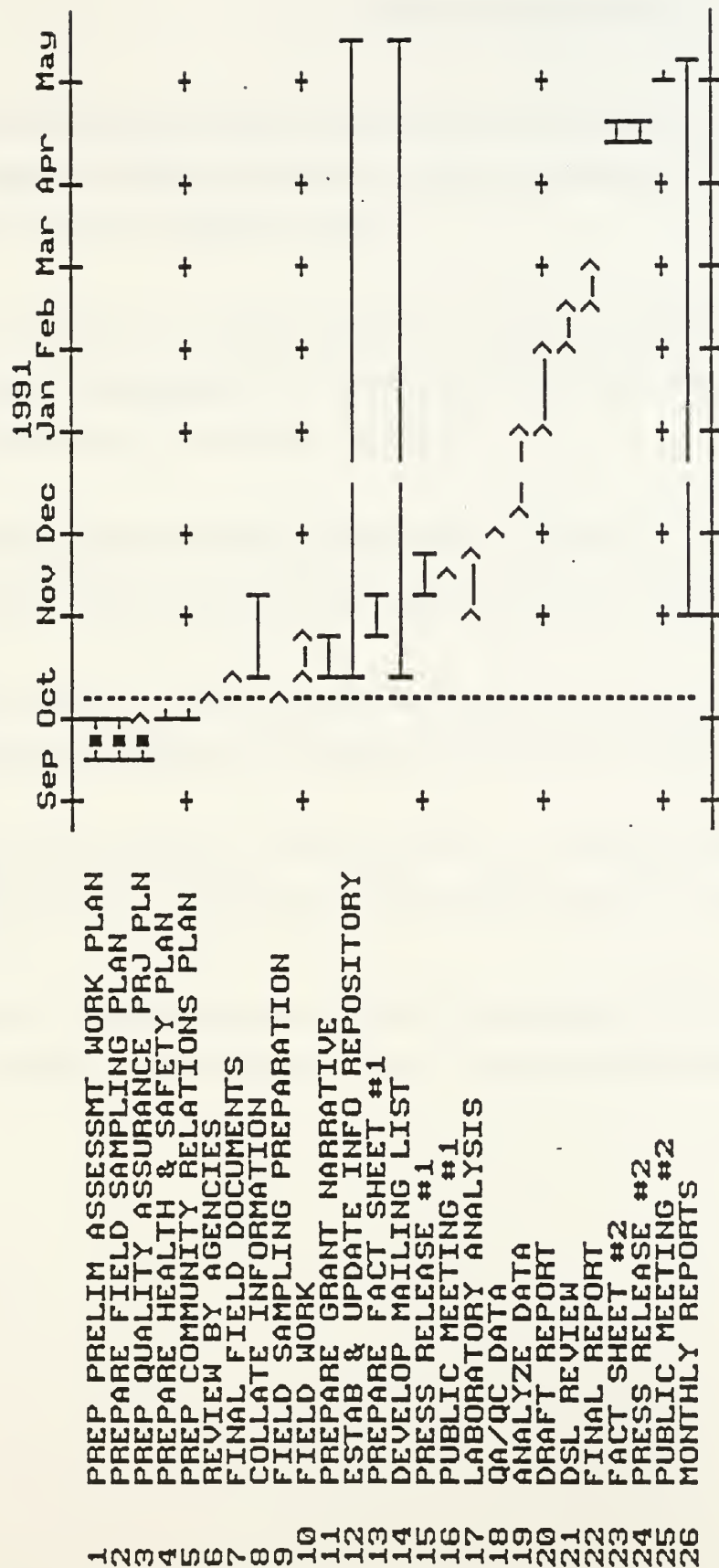
- ◆ A description of actions taken since the previous report toward completing the preliminary assessment.

- ◆ A description of all work, procedures, and submittals anticipated for the next reporting period.
- ◆ A description of all major modifications to the work plans made in the field.
- ◆ The identification of any event which may cause a delay in the work and a summary of efforts made to mitigate the delay.
- ◆ A summary of the status of all samples submitted to the analytical laboratory.

6.0 PROJECT SCHEDULE

Figure 3 illustrates the schedule for completing the preliminary assessment in the Galena Creek drainage. The schedule assumes that the majority of environmental sampling can be completed during fall, 1990. A draft preliminary assessment report will be submitted to AMRB during February, 1991.

FIGURE 3
GALENA CREEK PA
PROJECT SCHEDULE



7.0 REFERENCES CITED

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